

The copulatory complex of *Neurobasis chinensis chinensis* (Linn.) (Agriidae: Zygoptera)¹

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(With three text-figures)

This paper describes the structure of the copulatory complex of *Neurobasis chinensis chinensis* (Linn.).

Neurobasis chinensis chinensis (Linn.) is distributed throughout India, except in desert areas. The genus *Neurobasis* Selys, has two species, and one *Neurobasis chinensis chinensis* (Linn.) is found within Indian limits, along the banks of streams. They are generally characterised by the brilliant metallic green thorax, with very long and slim legs, wings moderately rounded at apices, especially hind wings, forewings considerably longer than hind wings, hind wings opaque, basal two thirds appearing brilliant metallic green or peacock-blue, pterostigma absent in all wings. Abdomen narrow, cylindrical, much longer than wings. Anal appendages black, supra-anal appendages much longer than the tenth abdominal segment.

As in other Zygoptera *Neurobasis chinensis chinensis* (Linn.) bears two sets of copulatory apparatus the first set which is primary in nature, is situated on the venter of the ninth and tenth abdominal segments as in other insects. The second set, regarded as the secondary complex is located ventrally on the entire second and the apical part of the third abdominal segments.

The first set is used for holding the female during copulation while the second set is used in actual coition.

PRIMARY COPULATORY COMPLEX

Fig. 1.

The primary copulatory complex consists of a median vestigial

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or primitive penis (VP), a pair of reduced appendages or gonocoxites (C) (=gonapophyses, Fraser 1956; gonopods, Snodgrass 1935; coxites, George 1928; valvules, Whedon 1918), a pair of supra-anal appendages (SAA) (=cerci, Snodgrass 1935), and a pair of infra-anal appendages (IAA) (=cerci, Fraser 1956; epiproct, Snodgrass 1935).

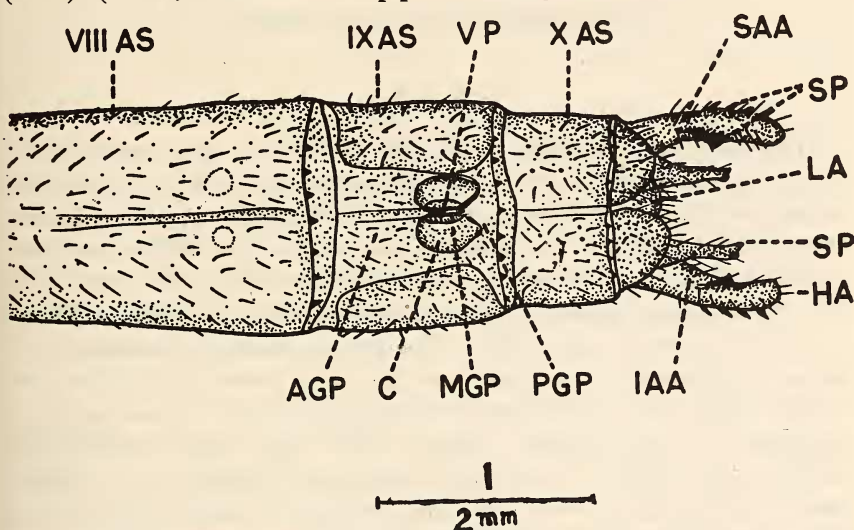


Fig. 1. Ventral view of the primary copulatory complex.

(i) *Vestigial penis* (VP).—The vestigial penis is represented by a reduced sclerite situated almost in the middle of the ventral surface of the ninth abdominal segment (AS). The vestigial penis has an elongated opening, the male gonopore (MGP) (=genital meatus, Fraser 1956).

(ii) *Coxites* (C).—The male gonopore (MGP) and the vestigial penis (VP) are guarded laterally by a pair of reduced, oval appendages or gonocoxites. The portions of the ninth sternum lying anterior and posterior to the male gonopore are modified to form the anterior and posterior genital plates (AGP & PGP) respectively. The anterior genital plate (AGP) is comparatively well developed.

(iii) *Supra-anal appendages* (SAA).—The supra anal appendages arise from the terminal end of the tenth abdominal segment (AS) from its dorso-lateral sides. They are long, sub-cylindrical near the base, forcepate, and curved towards each other, with rounded and slightly flattened apices. Each supra-anal appendage bears many spines (SP) on the outer and lateral margins near the apex and a prominent conical projection on the inner and lateral side, heavily covered with hairs.

(iv) *Infra-anal appendages* (IAA).—The infra-anal appendages also arise from the terminal end of the tenth abdominal segment, and lie ventral to supra-anal appendages and lateral to anus. They are

shorter than supra-anal appendages and broader proximally and narrower distally with blunt apices. The infra-anal appendages are widely separated at the base and covered with hairs and spines.

SECONDARY COPULATORY COMPLEX

Figs. 2 & 3.

The secondary copulatory complex consists of the genital fossa (GF) (=fenestra, Fraser 1956), the anterior lamina (AL), the posterior lamina, the lamina-batilliformis (LAB), the chitinous supporting framework (APSF & PPSF), the hamules, the penis vesicle (PV) (=vesicula spermalis, Fraser 1956; sperm-receptacle, Snodgrass 1935), the penis (P) (=prophallus, Fraser 1956; intromittent organ, Snodgrass 1935).

(i) *The genital fossa* (GF).—The genital fossa is a median, shallow and membranous depression on the entire second and apical part of third sterna. It is supported by three main sclerites. Anteriorly it is supported by the anterior lamina (AL), and lamina-batilliformis (LAB), posteriorly by a posterior lamina, and laterally by a complicated chitinous framework of sclerites. All the structures of the secondary complex are placed inside the fossa.

(ii) *Anterior lamina* (AL).—The anterior lamina is a chitinous, hood-like sclerite occupying the front part of the second venter and extending in between the two ventral margins of the second tergum. It is somewhat inverted V-shaped structure. The anterior margin of the anterior lamina (AL) is more or less straight and bears prominent laminar processes (LP), while the posterior margin is deeply notched. The inner and lateral walls of the notch are furnished with hairs and it encloses the proximal portion of the penis. The anterior lamina has two prominent borders, the inner border (IB) and the outer border (OB), the inner border is broader than the outer one.

(iii) *Lamina-batilliformis* (LAB).—The lamina-batilliformis is forceps-like chitinous structure lying inside the notch, in between the two arms of the inverted V-shaped anterior lamina (AL). According to Thompson (1908) the lamina-batilliformis may be regarded as penis sheath in *Zygoptera*, because it lies exactly in the same position as the penis sheath in *Anisoptera* and it also covers the proximal portion of the penis. The two arms (AR) of the lamina-batilliformis (LAB) are widely divergent, terminating into rounded apices and furnished with hairs.

(iv) *Posterior lamina*.—The posterior lamina is a simple chitinous plate, lying at the posterior end of the genital fossa. It is not visible externally, because it is completely covered by the anterior portion of

the penis vesicle (PV).

(v) *Supporting frame-work* (APSF & PPSF).—The genital fossa (GF) is strengthened and supported by a number of chitinous rods, which together constitute the complicated net work of chitinous bars, the supporting frame-work. The supporting framework supports the various parts of the copulatory complex and also provides the various surfaces or facets for the articulation of the copulatory organs with each other.

It is divisible into two portions, the anterior portion (APSF) and the posterior portion (PPSF). The anterior portion of the supporting framework lies below the anterior lamina (AL), and lamina-batilliformis (LAB). It consists of two prominent chitinous lateral bars (LB) which unite with each other at one end below the lamina-batilliformis, while on the other end the lateral bars are free, divergent and articulated with the posterior portion of the supporting framework (PPSF).

The anterior portion of the framework (APSF) supports the ante-

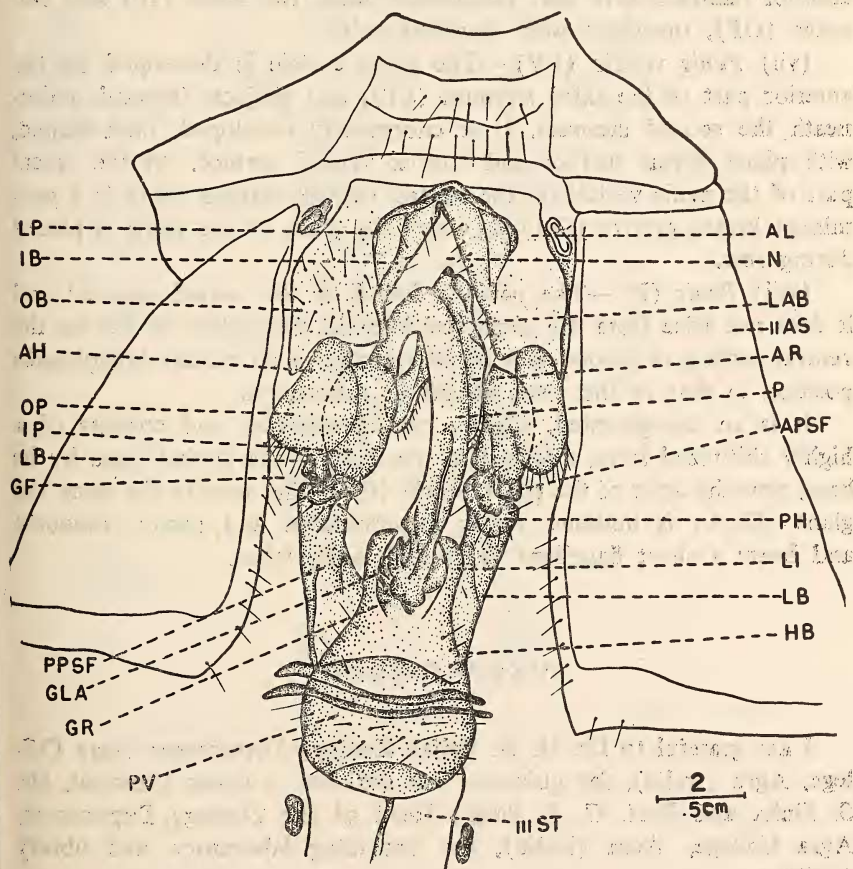


Fig. 2. Ventral view of the secondary copulatory complex with penis *in situ*.

rior lamina (AL), the lamina-batilliformis (LAB), the anterior pair of hamules (AH) and also the proximal part of the penis (P).

The posterior portion of the framework is very thick and well developed. It is somewhat U-shaped structure with two thick lateral bars (LB) and a horizontal bar (HB), lying below the anterior portion of the penis vesicle (PV). The posterior portion of the supporting framework (PPSF) supports the anterior portion of the supporting framework (APSF), posterior pair of hamules (PH), the apical portion of the penis vesicle (PV), together with the distal part of the penis (P).

(vi) *Hamules* (AH & PH).—The hamules are chitinous and robust structures, situated behind the anterior lamina (AL) and articulated with the framework. There are two pairs of hamules. The anterior pair of hamules (AH) are well developed while the posterior pair of hamules (PH) are reduced to papillae and situated at the junction of the anterior and posterior portions of the supporting framework. The anterior hamules have four prominent plates, two inner (IP) and two outer (OP), furnished with marginal hairs.

(vii) *Penis vesicle* (PV).—The penis vesicle is developed on the anterior part of the third sternum (ST), and projects forward underneath the second sternum. It is enormously developed, flask-shaped, with plane dorsal surface and convex ventral surface. At the apical part of the penis vesicle on the ventral convex surface, there is a prominent lipped groove (GR) in which the glans of the penis is placed during rest.

(viii) *Penis* (P).—The penis is found on the second segment and it does not arise from the penis vesicle as in Anisoptera. It lies on the ventral surface of second abdominal segment in an exactly homologous position to that of the penis sheath in Anisoptera.

It is an unsegmented, slightly curved structure and consists of a highly chitinized stem, attached to the floor of the genital fossa by its base, near the apex of the penis vesicle (PV). The apex of the stem, the glans (GLA) is bulbous, partly membraneous and partly chitinous; and bears a short flagellum (FL) and many lobes.

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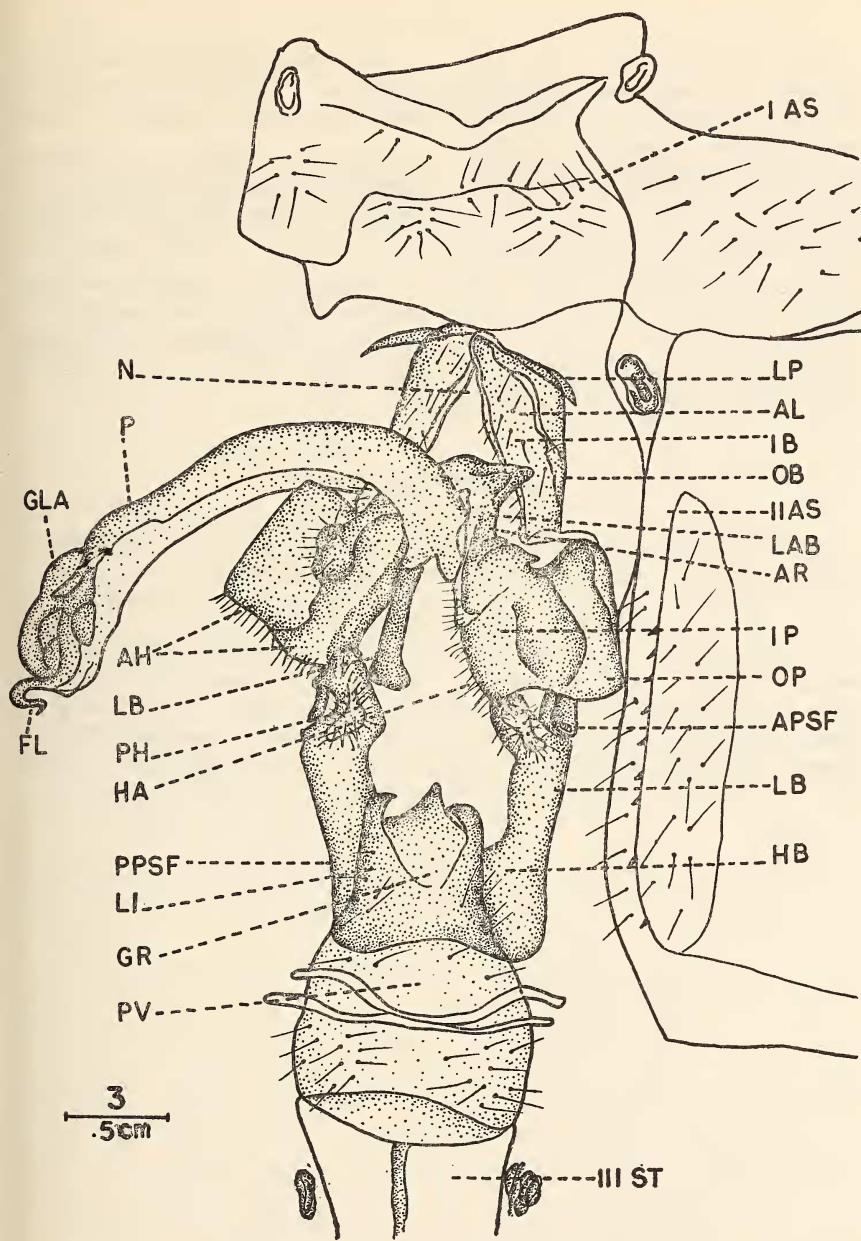


Fig. 3. Venetral view of the secondary copulatory complex with penis, displaced from its natural position.

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ABBREVIATIONS

AGP — Anterior genital plate; AH — Anterior hamule; AL — Anterior Lamina; APSF — Anterior portion of supporting framework; AR — Arm; C — Coxite; FL — Flagellum; GF — Genital fossa; GLA — Glans; GR — Groove; HA — Hair; HB — Horizontal bar; IAA — Infra-anal appendages; IB — Inner border; IP — Inner plate; LA — Lamina analis; LAB — Lamina-batilliformis; LB — Lateral bar; LI — Lip; LP — Laminar process; MGP — Male gonopore; N — Notch; OB — Outer border; OP — Outer plate; P — Penis; PGP — Posterior genital plate; PH — Posterior hamule; PPSF — Posterior portion of supporting framework; PV — Penis vesicle; SAA — Supra-anal appendage; SP — Spine; ST — Sternum; VP — Vestigial penis.